

REMARKS

This is intended as a full and complete response to the Final Office Action dated April 14, 2004, having a shortened statutory period for response set to expire on July 14, 2004. Please reconsider the claims pending in the application for reasons discussed below.

In the specification, the paragraphs 29, 31 and 34 have been amended to correct minor editorial problems.

Claims 7, 11-12, 14, 19-20, 22, 27-28, 31, 34, 37, 39-40, 42-46, 48-49 and 52-61 remain pending in the application upon entry of this response. Claims 41, 47 and 50-51 have been cancelled. Claims 7, 14, 22, 52 and 57 are amended. Claims 58-61 have been added. Support for claims 58-61 may be found throughout the specification, for example, paragraph 30. Reconsideration of the rejected claims is requested for reasons presented below.

Claims 41, 47, 51 and 57 were rejected under 35 U.S.C. 112 for failing to comply with written description requirements. The Examiner asserts that "PDMAT" is new matter. Applicant respectfully traverses the rejection.

Claims 41, 47 and 51 have been cancelled and claim 57 has been amended. However, the claimed subject matter the Examiner rejects has been incorporated into independent claims 7, 14, 22 and 52, respectively. Pentakis(dimethylamino)tantalum, referred to as pentadimethylamino-tantalum, $\text{Ta}(\text{NMe}_2)_5$ and/or PDMAT is supported throughout the specification, for example, paragraphs 30, 40 and 41. Withdrawal of the rejection is respectfully requested.

Claims 7, 11-12, 14, 19-20, 22, 27-28, 31, 34, 37, 39-40, 42-46, 48-49 and 52-56 stand rejected under 35 USC § 103(a) as being unpatentable over Cohen, U.S. Patent No. 6,610,151, (herein, "*Cohen*") in view of Kang, *et al.*, U.S. Patent No. 6,139,700, (herein, "*Kang*") and Wang, *et al.*, U.S. Patent No. 6,387,806, (herein, "*Wang*"). The Examiner states it would have been obvious at the time the invention was made to modify the device of *Cohen* with the disclosure of *Kang* in order to have an excellent coverage in the via. The Examiner further states that it would have been obvious for

one with ordinary skill in the art to modify the device of *Kang* with the metal dopant in the copper layer as disclosed by *Wang*. Applicant respectfully traverses the rejection.

Cohen discloses a cluster tool configured with a physical vapor deposition (PVD) chamber for copper deposition as well as several CVD chambers for copper and barrier depositions. *Cohen* remains silent to a cluster tool containing an ALD chamber. *Kang* discloses an ALD process to deposit titanium nitride or tungsten nitride as a barrier layer. *Kang* remains silent to any disclosure for an ALD chamber used for tantalum nitride deposition. *Wang* discloses methods for filling interconnect openings.

The Examiner states that *Kang* discloses that ALD processes are similar to CVD process and that ALD processes have excellent surface coverage; therefore, there is motivation to combine *Cohen* and *Kang*. Applicant asserts that ALD processes distinguish CVD processes; likewise, an ALD process chamber distinguishes a CVD process chamber. The present invention is claiming a system or apparatus with at least one ALD chamber and at least one PVD chamber.

In the Response to Arguments, the Examiner states that *Cohen* combined with *Wang* could produce a copper-aluminum or copper-zirconium alloy seed layer. The Examiner asserts that the deposition processes of *Cohen* and *Wang* may be combined to produce the present invention which is a system/apparatus. Applicant respectfully traverses the Examiner's argument. One skilled in the art would not be motivated to combine the CVD deposition process of *Cohen* with the process to fill interconnect openings of *Wang* and derive the system/apparatus of the present invention. The Examiner also asserts that *Cohen* discloses a tantalum nitride barrier layer. However, *Cohen* discloses that a CVD process may be used to form a tantalum nitride barrier layer, but remains silent to any disclosure of an ALD chamber for depositing tantalum nitride.

Therefore, *Cohen*, *Kang* and *Wang*, either alone or in combination, do not teach, show or suggest a system for processing a substrate, comprising at least one atomic layer deposition barrier chamber for depositing a barrier layer comprising tantalum nitride, wherein the at least one atomic layer deposition barrier chamber comprises a first source providing PDMAT and a second source providing ammonia, at least one physical vapor deposition metal seed chamber for depositing a copper alloy seed layer

over the barrier layer, wherein the copper alloy seed layer comprises copper and a metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof and wherein the metal is present in the copper alloy in a concentration between about 0.01 atomic percent and about 2.0 atomic percent, as recited in claim 7 and claims 11, 12, 31, 39-40 and 42-43 dependant thereon.

Also, *Cohen, Kang and Wang*, either alone or in combination, do not teach, show or suggest a system for processing a substrate, comprising at least one atomic layer deposition barrier chamber for depositing a barrier layer comprising tantalum nitride, wherein the at least one atomic layer deposition barrier chamber comprises a first source providing PDMAT and a second source providing ammonia, at least one physical vapor deposition copper alloy seed chamber for depositing a copper alloy seed layer over the barrier layer, wherein the copper alloy seed layer comprises copper and a metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof, and at least one physical vapor deposition undoped copper seed chamber for depositing an undoped copper seed layer over the copper alloy seed layer, as recited in claim 14 and claims 19-20, 34, 44-46 and 48-49 dependant thereon.

Also, *Cohen, Kang and Wang*, either alone or in combination, do not teach, show or suggest a system for processing a substrate, comprising at least one atomic layer deposition barrier chamber for depositing a barrier layer comprising tantalum nitride, wherein the at least one atomic layer deposition barrier chamber comprises a first source providing PDMAT and a second source providing ammonia, at least one physical vapor deposition metal seed chamber for depositing a metal seed layer over the barrier layer, wherein the metal seed layer comprises a metal selected from the group consisting of aluminum, magnesium, titanium, zirconium, tin, and combinations thereof, and at least one physical vapor deposition undoped copper seed chamber for depositing an undoped copper seed layer over the metal seed layer, as recited in claim 22 and claims 27-28 and 37 dependant thereon.

Also, *Cohen, Kang and Wang*, either alone or in combination, do not teach, show or suggest a system for processing a substrate, comprising at least one atomic layer deposition barrier chamber comprising a first source providing PDMAT and a second

source providing a nitrogen containing compound, at least one physical vapor deposition metal seed chamber having a copper alloy target comprising copper and a metal selected from the group consisting of aluminum, titanium, and combinations thereof and wherein the metal is present in the copper alloy target in a concentration between about 0.001 atomic percent and about 5.0 atomic percent, and at least one transfer chamber for transferring the substrate between the atomic layer deposition barrier chamber and the physical vapor deposition metal seed chamber, as recited in claim 52 and claims 53-57 dependant thereon.

Withdrawal of the rejection is respectfully requested. In conclusion, the references cited by the Examiner, alone or in combination, do not teach, show or suggest the invention as claimed.

Having addressed all issues set out in the Final Office Action, Applicant respectfully submits that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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